Teaching Statement — Debanjana Kundu

I consider myself fortunate to have learnt mathematics from some of the best teachers. One of the main reasons I wish to pursue a career in academia is so that I can share the under-appreciated beauty of mathematics with others. I have been a part of two education systems, with significantly different philosophies, and I believe this valuable experience will help me adapt to any teaching environment.

A major obstacle in teaching mathematics stems from the fact that most people believe mathematics is a subject meant only for those who are "born with it". *The Telegraph* published an article[1] in 2011, where the opening lines were "Being good at mathematics may be entirely pre-destined—you either have it or you don't". The article cites a paper from the psychology journal *Developmental Science* based on a study conducted at Johns Hopkins University. The idea that math ability is mostly genetic is one dark facet of a larger fallacy that intelligence is mostly genetic. Mathematical skills are increasingly important for getting good jobs these days — so believing you can not learn math is especially self-destructive. As a mathematician, and as a teacher, my primary goal is to help students move past this mindset.

In my experience, the traditional lecture style often reinforces students' beliefs about needing an innate ability to understand mathematics. They watch an experienced problem solver tackle questions with ease, often without making mistakes, as they arrive at their solutions. Students expect they should have a similar experience while attempting problems. When this does not happen, they quickly become frustrated. I constantly remind my students that everybody struggles with mathematics, including me. But the only way around is by practising. In the words of W. E. Hickson "if at first you don't succeed, try, try again".

Tutorials are crucial to an undergraduate level mathematics course. They reinforce key concepts, provide new perspectives, and create opportunities to work on problems with guidance. The environment tends to be more relaxed as there are fewer students and the tutors themselves are (graduate) students. Students can use this welcoming environment to explore new ideas and to test their understanding of lecture material.

As I look back at my undergraduate years, I realize that I learnt those subjects better where I would get "stuck" often and would discuss the material with my peers. I believe that an interactive style of teaching is the most effective one in smaller classes. When asked a question in class or during office hours, I prefer not to give away the answer immediately. I engage other students in the discussion and try to make them work out the answer to the question. During the early years of graduate school, I ran several tutorials. In recent years, I have carried my philosophy from these tutorials into my position as an instructor. After introducing a concept, I give a few examples and then give time in-class to work on a harder problem, often in small groups. During this time, I walk around to give ideas and/or hints and to make sure that they are on the right path. To encourage peer learning, I ask for volunteers to present their solutions. Often, the students are shy about presenting their work so I read through their solutions making sure it is correct. Once they know they have the right answer, they are more confident while presenting. This entire process is time consuming, but in my opinion they gain greater knowledge from solving problems with guidance. Whether it is a first year linear algebra course or an upper year advanced number theory course, I think my students go back home knowing that they can tackle hard problems.

Over the years, I have taught Linear Algebra, Calculus, and Multivariable Calculus to non-math majors. Unfortunately, most students need to register for these introductory courses because of university mandate and not out of an interest in mathematics. In such courses, I am willing to sacrifice a bit of rigour to make sure they remain enthusiastic till the end. Teaching my first Calculus II course in Winter 2018 was particularly challenging as this was my first experience of teaching a *flipped classroom*; it was also the first time I was teaching a class of 200 students. The biggest challenge in teaching large classes is that some students find the material too easy whereas some others find it too hard. It is difficult to hit the "Goldilock zone". I took regular (anonymous) feedback from students to make sure that majority of the students were comfortable. I encouraged those who continued to find the material difficult to come to my office hours. At the end of every lecture, we spent 15 minutes solving problems on Top Hat[2]; the focus

[1] https://www.telegraph.co.uk/education/educationnews/8693105/People-are-born-bad-at-maths.html
[2] http://www.tophat.com

was often on the subtle points. This application allowed me to post objective-type questions which the students could answer. I could see how many students got the correct answer and if a significant number of students answered incorrectly, I would encourage them to discuss the problem with fellow students and give them an opportunity to answer the question again. Almost always, this discussion with classmates proved helpful and majority of the students got the correct answer. Knowing which concepts students were struggling with, helped me prepare for the next lecture. Even though as a student I was never exposed to this style of lecturing, I have come to appreciate this relatively recent learner-centred model of instruction.

Just when I started feeling comfortable teaching large classes, we were hit by COVID-19 and teaching went online, literally overnight. This was a challenge for me, just as it was for everyone else. I coordinated a (multi-section) course on Multi Variable Calculus in Summer 2020. Our goals were modest; we wanted to be *adequate*. With trial and error, I realized that it is hard for students to stare and concentrate at a screen for long intervals of time; so I started teaching in 20-minute bursts followed by a short break. I shared my *OneNote notebook* with students to create a *blackboard-like* effect. This allowed students to look back at definitions, examples, or notations. I used *Breakout Rooms on Zoom*, *Piazza*, virtual study rooms, etc. to encourage students to continue discussing mathematics with their classmates. Even though we have once again returned to in-person classes, I continue to incorporate some of these features, like teaching in short bursts and maintaining a *OneNote notebook* for lecture notes and recording my lectures.

At my current institution (UTRGV), class sizes are small – e.g., my honours Algebra course had 15 students. Now, there are new challenges. Almost all our students are first generation and work part-time or full-time, in addition to taking 5 courses per semester. I needed to redesign my courses to support learning. For example, I no longer enforce homework deadlines students can submit their assignments till the day before the final exam. I continue to be (pleasantly) surprised by the number of students who complete their pending homework before the final exam and do well on the test. Every few weeks, I bring in-class worksheets which allows for group discussions. Even when students are unable to complete their homework, this approach allows them to practice a few problems and clarify misconceptions. I assign peer learning assignments where students grade a peer's solution to a problem following my rubric – this gives them an idea of how much details are necessary for an answer to be complete and how to present an answer.

In every endeavour, I make it clear to my students and peers that they are welcome to ask questions, that making mistakes is how you learn, and that developing good problem solving skills takes time and effort.

Over the years, I have organized semester-long learning seminars involving undergraduate students, graduate students, post-docs and faculty members. The goal has been to establish a sense of community, improve communication skills, and also learn about different areas of math not necessarily related to my research.

As a part of the University of Toronto Outreach Program[3], I mentored three high school students between 2018 and 2020. Students came from varied backgrounds; some were interested in competitive mathematics whereas some found high school mathematics boring and wanted to do "fun" math. It was a wonderful experience to work with such students as it allowed me to design projects geared towards their interests.

Since 2021, I have regularly mentored undergraduate students. I was a mentor for Adithya Chakravarthy's bachelors thesis at the University of Toronto which resulted in a single-author publication. In my current job, I have offered independent reading courses to students outside of regular class hours. I am currently mentoring two (final year) bachelors projects and one masters project. In addition, I am also running an introductory elliptic curves seminar course geared towards undergraduates during Fall 2024.

I am eager to design a course on computational Number Theory with emphasis on working through examples using SAGE. I intend to bring the courses I teach closer to my area of research and whenever possible introduce students to undergraduate research. In addition to my teaching experience, I have given talks at conferences and seminars about my research. Although these talks are on completely different subjects than what I teach my students, they give me the necessary experience of addressing a large audience. I strive to become a better educator who is knowledgeable, competent, and respectful to my students.

[3] https://www.mathematics.utoronto.ca/outreach/current-programs/grades-9-12-programs/math-mentorship

Mentorship Activities

Below is a table of high school, undergraduate, and graduate students I have mentored since 2018.

Name	Institution	Course	Year	Topic
Anna Krokhine	High School	Mentorship	2018	Graph Theory
Maya Bozo-Ray	High School	Mentorship	2019	Benford's Law
Jennifer Wang	High School	Mentorship	2020	Number Theory
Adithya Chakravarthy	UofT	Bachelors Thesis	2021–23	Iwasawa Theory
Vitthal Yelambalse	BITS Goa, India	Bachelors Thesis	2022	Cyclotomic Fields
Shubhrojyoti Dhara	ISI B, India	Summer Project	2023	Elliptic Curves
Léonie Chipot	UOttawa	Summer Project	2023	Proof Writing
Samyak Jha	IIT B, India	Reading Project	2023	p-adic L-functions
Raul Marquez	UTRGV	Reading Project	2023–24	Elliptic Curves
Gourab Mukhopadhyay	UTRGV	Research Project	2024	Fibonacci Numbers
Nandini Parkhi	IISER Bhopal, India	Summer Project	2024	p-adic Numbers
Aniruddha Mandal	IISER Mohali, India	Summer Project	2024	p-adic Numbers
Raul Marquez	UTRGV	Bachelors Thesis	2024–present	Elliptic Curves
Alejandro Delgado	UTRGV	Reading Project	2024–present	Group Theory
Ama Quansah	UTRGV	Masters Project	2024–present	Fibonacci Numbers

Feedback from students (Courses)

In 2021, I was nominated for the UBC Mathematics Department's Postdoctoral Teaching Prize[4]. I include here some of the comments I have received in the mid semester or end of semester surveys over the years:

1. "I thought Dr. Kundu was very organized this semester in terms of her notes and providing us with information regarding assignments, midterms, and the final. She was always open to answering student's questions. I think it was a great idea to include bonus marks for students and I think this should be continued in future terms as it gives students a chance to practice while potentially boosting their grade." – MAT105 (Calculus) UBC

2. "Dr. Kundu explained the concept well by using quite a few practice questions during class. In addition, she provided us with extra practice questions which were pretty helpful." – MAT105 UBC

3. "I enjoyed attending Professor Kundu's class. She communicated the material really well and she made math more fun. I found the weekly practice problems helpful as I always did them as extra practice and it allowed for me to brush up on topics that I had difficulties on." – MAT105 UBC

4. "Very respectful, dilligent, and dedicated teacher. Always made time to make sure students understood if they still had questions." – MAT105 UBC

5. "I loved Professor Kundu's style of lectures. She would take the notes with us and do a lot of practice questions and made sure that we had a full understanding before she moved forward. Not only is she a very effective teacher she also showed that she cared for our well being and is a very welcoming person." – MAT105 UBC

6. "Deb always made an effort to answer my emails and my questions in a timely manner and was very kind and respectful to me when I spoke with her. ... Deb is a lovely person who cares about her students, and made lots of effort to connect with us which was greatly appreciated." – MAT105 UBC

[4]Nominations are from students or supervisors.

7. “Very effective that she asked about what she can do to change and improve the course.” – MAT105 UBC

8. “The professor is really good at asking for/answering questions and the pace if the lectures was good.” – MAT152 (Linear Systems) UBC

9. “Material presented in such way that inspired learning and made it interesting. The instruction was clear and easy to understand.” – MAT152 UBC

10. “The practice midterms are very useful and applicable.” – MAT152 UBC

11. “Instructor was very available and willing to help with explanations. Enjoyed PLA (Peer Learning Assignment) especially the one we graded eachothers to see how others work. Instructor encouraged us to work together as you learn best from speaking with others. ” – MATH2413 (Linear Algebra) UTRGV

12. “This professor is one of the best math teachers I’ve ever had!” – MATH2413 UTRGV

13. “You are an amazing mathematics teacher! It was a pleasure learning from you this semester.” – MATH2413 UTRGV

14. “She was always very helpful, understanding, and gave clear instructions.” – MATH2413 UTRGV

15. “Definitely enjoyed many of the aspects of the course, but wished there could’ve been more group assignments and work. Enjoyed the pacing and structure” – MATH3363 (Algebra I) UTRGV

16. “Please continue to provide recorded lectures and notes. I struggled to keep up with the material so this was very helpful to have. I also liked that you were available outside of office hours. And when I went you were very kind and understanding of my situation. You seem to genuinely care about wanting your students to learn. UTRGV could use more professors like you so I hope you’re here for a long time. Thanks again for all the help” – MATH3363 UTRGV

17. “The professor was helpful, and the homework and review problems were useful for preparing for quizzes/midterms.” – MATH3363 UTRGV

18. “Very understandable and cognizant of students’ situations. Provided opportunities and then some.”– MATH3363 UTRGV